Florida Department of Health
Florida Onsite Sewage Nitrogen Reduction Strategies Study

Contract CORCL

TASK B.8

Operation, Maintenance and Repairs Report for Passive Nitrogen Reduction System B-HS6

March, 2015

Task B of the Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified in FOSNRS Task A.9 and pilot tested in Task A.26. To meet this objective, full-scale treatment systems were installed at various residential sites in Florida, operated on septic tank effluent (STE) under actual onsite conditions, and monitored over an extended timeframe. This report summarizes the operation, maintenance, and repairs required for the passive nitrogen reduction system (PNRS) installed at a home site in Wakulla County, Florida (B-HS6) in November, 2013. Design and construction details were presented previously in the Task B.6 Field System Installation Report for this system. The field system monitoring reports that document system performance, operation, and maintenance issues were presented previously in Task B.7 documents for each monitoring event. The B-HS6 system performance was monitored from November 2013 to January 2015.

The current PNRS system replaced the previously installed PNRS system installed at field site B-HS1. The previously installed components that were removed were the Aerocell™ unsaturated media filter chamber, Nitrex™ media and split recirculation device. The current PNRS system consists of a 1,500 gallon septic tank, 275 gallon pump tank, two PNRS treatment tanks and a drainfield. The B-HS6 PNRS tankage includes a 1,650 gallon concrete tank to house a combined Stage 1 and Stage 2a media biofilter and a 1,500 gallon single chamber tank which had contained the Nitrex™ media was converted to a Stage 2b saturated sulfur media biofilter. The treated effluent from the Stage 2b biofilter is discharged into the soil via the drainfield (standard Infiltrator EQ36 Quick 4 trenches).

During start-up, an alarm indicated a pump failure and upon inspection loose wiring was discovered and repaired. PNRS flow readings indicated that the pump had not run since installation until the time the wiring was repaired, therefore the official start-up of the PNRS system was November 14, 2013 (Experimental Day 0).

Overall this system did require oversight and maintenance throughout the study period. There were two primary issues both related to the Stage 1&2a tank: the distribution sprayers and the outlet pipe. The pump tank contents are discharged to the top of the Stage 1 biofilter via spray nozzles. During preliminary sampling, it was observed that the sprayers were not spraying uniformly over the Stage 1 media surface. Therefore on December 21, 2013, the sprayers were rotated to spray up on the tank lid rather than straight down for better distribution over the media surface. The results from the SE1 DP1

and DP2 samples indicated significant nitrification was occurring with this sprayer set-up; however, the long-term operation and maintenance of the sprayers in this set-up was a concern. Therefore, on March 20, 2014, the four originally installed spray nozzles were replaced by three Orenco™ spin nozzles positioned under the tank lids allowing for easy maintenance and maximum spray coverage. During a system check on October 3, 2014, two of the Orenco™ spin nozzles were observed to be spinning slowly and not providing full coverage. New nozzles were installed on October 20, 2014 prior to sample event no. 6.

The second issue with the Stage1&2a tank was related to hydraulic blockages in the system. Based on the hydraulic design of the system, a normally expected water level in the Stage 1&2a tank would be approximately 98.52 ft. elevation, or a depth above tank bottom of 4.8 inches. The normal operation level in the Stage 1&2a tanks therefore could be expected to vary between 4 and 6 inches above the tank bottom. Water levels above these values could adversely affect treatment performance and would suggest hydraulic blockages in the system. While purging the Stage 1 effluent drive points DP1 and DP2 during Sample Event No. 2, it was observed that the water level in the Stage 1&2a tank was elevated above the pans holding the drive points. The water level in the Stage 1&2a tank was found to be elevated approximately 10-inches above the invert of the collection pipe during that sample event. This water level would saturate all 12-inches of the lignocellulosic media and approximately 2-inches of the expanded clay media. The elevated water level could quite possibly have affected the performance of the system as monitored in Sample Event 2. A piezometer was installed within the Stage 1&2a tank on April 10, 2014 to provide better access to water level observations.

On April 14, 2014, it was determined the clog in the system was in the inlet pipe on the Stage 2b sulfur tank. An unsuccessful attempt was made with a plumbing snake to clear the clog. On April 16, 2014, the clog was cleared using compressed air and a 4-inch rubber bladder; the water level in the Stage 1&2a tank was restored to normal operational levels. During the following monitoring event, Sample Event No. 3, the water level in the Stage 1&2a tank was at normal operational levels. A system check on May 27, 2014 indicated that the water level was elevated approximately 8 inches above the tank bottom. A repair on the inlet pipe to the Stage 2b sulfur tank was completed on May 31, 2014. The repair included drilling additional holes in the inlet pipe and replacing the mesh material surrounding the pipe with a different type with larger mesh size to prevent future clogging. During a system check on September 26, 2014, the water level in the Stage 1&2a tank piezometer was again elevated by approximately 8 inches. This could have resulted in greater saturation of lignocellulosic media in Stage 2a, but submergence of the pans holding drive points DP1 and DP2 would not be expected. It was determined that the outflow pipe of the Stage 1&2a tank was partially clogged. A clean out was installed on the outflow pipe, just downgradient of the Stage 1&2a tank on October 9, 2014 which allowed access to clean the perforations from inside the effluent collection pipe. In addition, additional holes were drilled in the effluent collection pipe (from inside the pipe) inside the tank.

Much of the increased maintenance and repairs associated with this system were due to problems in design and construction of the system. We attempted to use parts from the previous PNRS system to save cost, and this resulted in several of the problems we experienced. Future systems of this type should have a better underdrain design for the Stage 1&2a tank and improved inlet to the Stage 2 upflow sulfur biofilter, without bends between the two tanks. In addition, a simpler Stage 1 dosing system, without sprayers, should be considered. An improved design and better construction materials would eliminate most of the operational problems with this system and result in a very simple to operate system.

A description of the start-up issues, routine operation and maintenance items (O&M), the entity that performed the repair/maintenance, and the associated cost are included in Table 1. Table 2 is the summary log of repairs, maintenance actions, inspection results and system observations since start-up. This data, along with data from the other full-scale systems evaluated in Task B, will be used to estimate O&M effort and cost for full-scale passive nitrogen reduction systems (PNRS) in the Life Cycle Cost Analysis (Task B.13).

Table 1. Site B-HS6: Summary of start-up, routine operation and maintenance issues, repairs and refinement actions

Date	Start-up Issues	Routine Operations & Maintenance Issues	Repairs	System Refinement	Time Required (hr)	Estimated Cost[1]
11/14/13	ME rewired the pump and controls				2	$150.00
11/20/13	H&S cleaned Stage1&2a sprayers				0.5	$37.50
12/20/13		H&S cleaned Stage1&2a sprayers			0.5	$37.50
12/21/13		H&S adjusted Stage1&2a sprayers			0.5	$37.50
1/9/14			H&S repaired vents on Stage 1&2a tank with mastic		0.5	$37.50
3/20/14			H&S replaced Stage1&2a sprayers		1.5	$112.50
4/10/14				H&S installed piezometer in the Stage 1&2a tank	2	$150.00
4/14/14			H&S attempted to clear clog in the inlet pipe to Stage 2b tank with plumbing snake		1	$75.00
4/16/14			H&S cleared clog in inlet pipe to Stage 2b tank witih compressed air and rubber bladder		1.5	$112.50
5/30/14			H&S started repair of sulfur tank inlet pipe		3	$225.00
5/31/14			H&S finished repair of sulfur tank inlet pipe		5	$375.00
10/7/14			H&S started installation of clean-out on Stage 1&2a outlet pipe		4	$300.00
10/9/14			H&S finished installation of clean-out on Stage 1&2a outlet pipe		6	$450.00
10/16/14		H&S cleaned PNRS flowmeter	H&S added perforations to Stage1&2a effluent collection pipe inside the tank		4.5	$337.50
10/19/14			H&S added perforations to Stage1&2a effluent collection pipe inside the tank		3.5	$262.50
10/20/14			H&S replaced Stage1&2a sprayers		0.5	$37.50

ME = maintenance entity = Apalachee Backhoe and Septic

H&S = Hazen and Sawyer (field technician)

HO = homeowner

CHD = county health department

[1]An hourly rate of $75 was assumed for maintenance entity labor.

Table 2. Site B-HS6: System inspections, observations, maintenance actions, and repairs log

Date	Description
9/12/2013	Checked system. Met with contractor regarding second system construction.
11/5/2013	Construction - Stage1&2a combination tank and pump tank installed.
11/6/2013	Construction - Electrical work, finished installation.
11/14/2013	High water alarm in pump tank. Pump was not working.
	Contractor repaired loose wiring. Pump had not run from time of installation.
	Cleaned two Stage 1&2a sprayers clogged with construction debris.
	System Start-up
11/20/2013	Preliminary Sample Event No. 1
	No ponding in drainfield observation ports.
	Cleaned all four Stage 1&2a sprayers - not clogged but were not spraying properly.
12/4/2013	Preliminary Sample Event No. 2
	Ponding of 1.5 inches in drainfield obs. port #2, other three ports were dry.
12/20/2013	Preliminary sampling indicated nitrification was insufficient.
	Checked and cleaned Stage 1&2a sprayers.
	Even after cleaning, majority of spray going straight down.
12/21/2013	Rotated Stage 1&2a sprayers so they are spraying straight up on the tank lid.
	Observed better coverage of Stage 1 media
1/9/2014	Site visit. System ok.
	Observed that vents on Stage 1&2a tank were pushed down (kids had pushed down).
	Vents were pulled back up and resealed with existing mastic.
	The owner has not mentioned any odor concerns.
1/22/2014	Sample Event No. 1
3/7/2014	Site visit. System ok. Observed one of the sprayers had a broken tip.
	Ponding of ¼ inch in observation port #2, all others dry.
3/20/2014	Removed existing Stage 1&2a sprayers replaced with 3 Orenco™ sprayers.
3/24/2014	Site visit. System ok.
	Ponding of 1/4 inch in observation port #2, all others dry.
4/10/2014	Sample Event No. 2
	Water level within Stage 1&2a tank elevated approximately 14-inches.
	Installed piezometer in the Stage 1&2a tank.
4/14/2014	Attempt to clear clog in the inlet pipe to Stage 2b tank with plumbing snake.
4/16/2014	Cleared clog in inlet pipe to Stage 2b tank with compressed air and rubber bladder.
	Water level in piezometer in Stage 1&2a tank dropped by approximately 12 inches.
4/28/2014	System Check. Ponding of 1/4 inch in observation port #2, all others dry.
	Stage 1&2a sprayers working well. Water level in ST1&2a sample port elevated by less than 2 inches.
5/7/2014	Sample Event No. 3.
	Water level in ST1&2a sample port elevated by approximately 4 inches.
5/27/2014	System Check
	Water level in ST1&2a sample port elevated by approximately 8 inches
5/30/2014	Started repair of sulfur tank inlet pipe. Drained tank, removed a portion of sulfur.
5/31/2014	Finished removing sulfur from the tank to access inlet pipe at the bottom of media.
	Repaired inlet pipe to sulfur tank and placed sulfur back into the tank.

Table 2 (cont.). Site B-HS6: System inspections, observations, maintenance actions, and repairs log

Date	Description
6/23/2014	Sample Event No. 4
	Water level in Stage 1&2a tank at normal operational level.
7/21/2014	System Check
	Water level in Stage 1&2a tank elevated by approximately 1 inch.
8/27/2014	Sample Event No. 5
	Water level in Stage 1&2a tank elevated by approximately 2 inches.
9/26/2014	System Check
	Water level in Stage 1&2a tank elevated by approximately 8 inches.
10/3/2014	System Check
	Water level in Stage 1&2a tank elevated by approximately 7 inches.
	Two end sprayers are spinning slow, not full coverage.
10/7/2014	System repair
	Began installation of cleanout on outflow pipe of Stage 1&2a tank.
10/9/2014	System repair
	Finished installation of cleanout on outflow pipe of Stage 1&2a tank.
10/16/2014	System repair
	Drilled holes in Stage1&2a effluent collection pipe, inside of Stage 1&2a tank.
	Cleaned PNRS flowmeter. This increased dose volume back to normal level.
10/19/2014	System repair
	Drilled additional holes in Stage1&2a effluent collection pipe, inside tank.
10/20/2014	System repair
	Replaced all three Stage 1&2a sprayers with new ones.
10/30/2014	Sample Event No. 6
	Water level in Stage1&2a tank at normal operational level.
11/26/2014	System Check
	Water level in Stage1&2a tank at normal operational level.
12/29/2014	Sample Event No. 7
	Water level in Stage1&2a tank at normal operational level.
1/16/2015	System Check
	Water level in Stage1&2a tank at normal operational level.
1/29/2015	Sample Event No. 8
	Water level in Stage1&2a tank at normal operational level.